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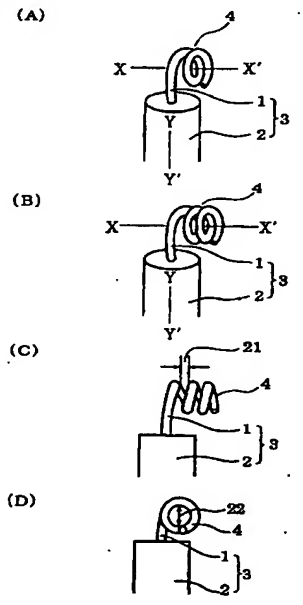
(54) INSULATED WIRE WITH SPIRAL TERMINAL AND METHOD OF CONNECTING THE WIRE

(57) The invention intends to simplify the connecting operation of an insulated wire and a pin terminal, and to reduce the cost of connection. A spiral part of the insulated wire having a spiral end according to the invention is formed by removing an insulation at an end of the insulated wire to expose a conductor, and winding the exposed conductor into a spiral form by 1.5 folds or more to produce a spiral part. The insulated wire and the pin terminal are connected in such a manner that the pin terminal is inserted into the central opening of the spiral part, and the spiral part and the pin terminal are fixed with a fixing material, such as solder, or binding agent having a high conductivity. When a solder coating is formed on the conductor in the spiral part, it is possible to fix the spiral part and the pin terminal only by heating the spiral part to melt the coating solder.

FIG. 1



EP 1 076 341 A1

Description

Technical Field

[0001] The present invention relates to an insulated wire having a spiral end to be used by connecting, for example, to a pin terminal of an electronic device, and a method for connecting the insulated wire.

Background Art

[0002] In recent years, electronic devices are becoming increasingly miniaturized.

[0003] Therefore, connecting a conductor of an insulated wire to a pin terminal, for example, requires that the connecting part itself be compact and the operation for connecting be conducted in a narrow space.

[0004] Furthermore, it is also required that the workability is good, operating cost is low, the cost of parts used for connecting is low, and that in order to protect the parts to be connected through a pin terminal from heat, the parts are not heated for a prolonged period of time during the connecting operation, and in order to prevent the formation of sparks on the application of high voltage, the connecting part has no protrusions, the contact resistance is small, and that the strength of the connecting part is large enough to prevent from releasing easily.

[0005] However, in view of the requirements described above, the connecting methods of the related arts involve many problems. The connecting methods of the related arts and problems thereof are described below with reference to Figs. 6A and 6B and Figs. 7A to 7C. In these figures, numeral 15 denotes a conductor, 16 denotes an insulated wire, 17 denotes a pin terminal, 18 denotes solder, 19 denotes a caulking sleeve, and 20 denotes a caulking terminal.

[0006] In the connecting method shown in Figs. 6A and 6B, a tip end of a conductor 15 exposed by removing an insulation at an end of an insulated wire 16 is accompanied by a pin terminal 17 as shown in Fig.6A, and then the pin terminal 17 and the conductor 15 are fixed with solder 18 as shown in Fig. 6B.

[0007] This connecting method involves the following problems. The workability is poor because to solder a holding fixture to accompany the conductor and the pin terminal, an operator must be skilled in soldering; poor soldering brings about a inferior connection strength; and there is a possibility that the pin terminal is heated by soldering for a protracted time.

[0008] In the connecting method shown in Fig.7A, a conductor 15 exposed by removing an insulation at an end of an insulated wire 16 and a pin terminal 17 are inserted into a caulking sleeve 19 respectively from both ends thereof, and the caulking sleeve 19 is crimped from the outside thereof to fix the conductor 15 and the pin terminal 17 inside the caulking sleeve.

[0009] This connecting method also has other problems.

[0010] The caulking sleeve, which is required in connecting, is expensive, the length of the connecting part becomes elongated because of the use of the caulking sleeve, and a space into which a crimping tool is inserted upon connecting is required.

[0011] In the connecting method shown in Fig. 7B, a caulking terminal 20 having a ring is fixed at a tip end of a conductor 15 exposed by removing an insulation at an end of an insulated wire 16. At this time, the conductor 15 and the insulated wire 16 are respectively clamped with claws equipped at two positions of the caulking terminal 20. A pin terminal 17 is inserted in the ring of the caulking terminal 20, and the pin terminal 17 and the ring are fixed by soldering (not shown in the figure).

[0012] This connecting method involves the following problems. That is, while the pin terminal and the ring are soldered, the connection strength is insufficient because the ring is of a single fold; the caulking terminal having a ring, which is required in connecting, is expensive; and there is a possibility that the pin terminal is heated for a protracted period of time by soldering.

[0013] In the connecting method shown in Fig. 7C, a tip end of a conductor 15 exposed by removing an insulation at an end of an insulating wire 16 is wound several times around a pin terminal 17, and the conductor 15 and the pin terminal 17 are fixed by soldering (not shown in the figure).

[0014] This connecting method involves the following problems. That is, space is required for winding the conductor; there is a possibility that the pin terminal is heated for a long time by soldering; and a protrusion of solder is liable to form at the connecting part because soldering is conducted after winding the conductor.

Disclosure of Invention

[0015] This invention intends to provide a method for easily connecting a conductor of an insulated wire to a pin terminal at low cost while the problems associated with the related art connecting methods of a conductor of an insulated wire to a pin terminal as described above are removed to the extent as possible, and to provide an insulated wire having a spiral end for the connecting method.

[0016] The invention relates to an insulated wire having a spiral end produced by a process comprising the removal of insulation at an end of an insulated wire to expose a conductor; and winding the exposed conductor into a spiral form by 1.5 folds or more to produce a spiral part at an end of the conductor.

[0017] The insulated wire having a spiral end can be easily connected to a pin terminal by a method for connecting an insulated wire having a spiral end comprising inserting a pin terminal into a central opening of the spiral part, and fixing the spiral part and the pin terminal with a fixing material, such as solder or binding

agent having a high conductivity.

[0018] It is possible that a solder coating is previously formed on the spiral part of the conductor, and after inserting the pin terminal into the central opening of the spiral part, the spiral part is heated to electrically connect the pin terminal and the insulated wire having a spiral end by melting the solder coating. In this case, the heating time is short, and the workability is improved, so that an electronic device, such as a cold cathode tube, to which the pin terminal is connected, is not damaged by heat. Furthermore, the contact resistance at the connecting part can be made small, and the fixing strength at the connecting part can be increased.

[0019] In the case where a stranded wire is used as the conductor, it is preferred that the spiral part has a spiral direction opposite to a stranding direction of the stranded wire, whereby the stranded wire can be prevented from unraveling on forming the spiral part.

Brief Description of Drawings

[0020]

Figures 1A and 1B are perspective views showing embodiments of an insulated wire having a spiral end according to the invention, Fig. 1C is an elevational view showing the embodiment shown in Fig. 1B, and Fig. 1D is an elevated view of the embodiment in Fig. 1B shown from another direction;

Figures 2A and 2B are perspective views showing other embodiments of an insulated wire having a spiral end according to the invention;

Figures 3A and 3B are cross sectional views showing embodiments of a conductor having a solder coating;

Figure 4A is a perspective view showing a conductor comprising a stranded wire, and Fig. 4B is a perspective view showing an insulated wire having a spiral end comprising an insulated wire having a stranded conductor;

Figure 5 is a perspective view showing an example of a connecting part using an insulated wire having a spiral end according to the invention;

Figures 6A and 6B are perspective views showing an example of connecting a conductor of an insulated wire and a pin terminal according to the related art techniques; and

Figures 7A to 7C are perspective views showing other examples of connecting a conductor of an insulated wire and a pin terminal according to the related art techniques.

Best Mode for Carrying Out the Invention

[0021] Figures 1A to 1D, 2A and 2B are perspective views and elevated views showing embodiments of an insulated wire having a spiral end according to the invention. In the figures, numeral 1 denotes a conductor, 2 denotes an insulation, 3 denotes an insulated wire, and 4 denotes a spiral part.

[0022] As the insulation, plastics, for example, the flame-retardant polyolefin is used. But, in this invention the material of the insulation is not particularly limited.

[0023] The spiral part 4 can be formed in such a manner that the insulation 2 at an end of the insulated wire 3 is removed to expose the conductor 1, and the exposed conductor 1 is wound around a machining pin to form into a spiral form.

[0024] Figures 1A to 1D show embodiments where the central axis X-X' of the spiral intersects the central axis Y-Y' of the insulated wire at substantially right angles. In the embodiment shown in Fig. 1A, the spiral is wound by 2 folds, and in the embodiment shown in Fig. 1B, the spiral is wound by 3 folds. In the case where the spiral is wound by 1.5 folds or more, when a pin terminal inserted into a central opening of the spiral is slanted in any direction, the pin terminal is in contact with the spiral at three positions, so as to limit the slant of the pin terminal.

[0025] When the spiral is wound by 2 folds or more, the angle formed by the pin terminal inserted into the spiral is further limited, to stabilize temporary fixing. When the spiral is wound by 5 folds or more, on the other hand, it is not preferred because the process for forming the spiral becomes complicated, and the workability of inserting the pin terminal becomes poor.

[0026] Figure 1C is an elevated view of the embodiment shown in Fig. 1B, in which numeral 21 denotes a gap of the spiral. The gap of the spiral is preferably from 0 to 0.1 mm, and more preferably from 0 to 0.05 mm. When the gap is too large, the pin terminal may be caught on the spiral when inserting the pin terminal, so as to deteriorate the workability of insertion.

[0027] Figure 1D is an elevated view of the embodiment shown in Fig. 1B from another direction, in which numeral 22 denotes an inner diameter of the spiral. The inner diameter is preferably from -0.5 to +2 mm, and more preferably from -0 to +1 mm, of the outer diameter of the pin terminal to be inserted. When the inner diameter of the spiral is too small, the workability of inserting the pin terminal is deteriorated, and when the inner diameter of the spiral is too large, the workability of soldering is deteriorated.

[0028] Figures 2A and 2B show other embodiments of the insulated wire, in which the central axis X-X' of the spiral and the central axis Y-Y' of the insulated wire are substantially parallel. In the embodiment shown in Fig. 2A, the spiral is wound by 2 folds, and in the embodiment shown in Fig. 2B, the spiral is wound by 3 folds.

[0029] The central axis X-X' of the spiral may be in

a slanted direction with respect to the central axis Y-Y' of the insulated wire.

[0030] In the case where the central axis X-X' of the spiral and the central axis Y-Y' of the insulated wire are substantially parallel, a pin terminal can be inserted into a central opening of the spiral by simply pushing the insulated wire 3 in the direction of the pin terminal by hand, and the operation of inserting the pin terminal into the spiral part 4 can be easily conducted.

[0031] The embodiment, in which the central axis X-X' of the spiral intersects the central axis Y-Y' of the insulated wire at substantially right angles, is very convenient in the case where a device is arranged so as to occupy the whole width of an apparatus, and a wire has to be connected to a pin terminal at right angles, for example, in the case of connection at a terminal of a backlight of a liquid crystal display of an electronic apparatus.

[0032] A copper stranded wire or a tinned copper stranded wire, comprising 7 strands of 0.1mm wire, or 19 strands of 0.16mm wire, may be used as the conductor of the insulated wire.

A copper single wire and a tinned copper single wire, having a diameter of from about 0.2 to 0.6 mm, may also be used as the conductor.

[0033] In this invention, however, the size or the material of the conductor is not particularly limited.

[0034] Figures 3A and 3B are cross sectional views showing embodiments of a conductor having a solder coating, in which numeral 5 denotes a tinned copper single wire, 6 denotes a solder coating, 7 denotes a conductor, 8 denotes a tinned copper stranded wire, 9 denotes a solder coating, and 10 denotes a conductor. While the solder coatings 6 and 9 may be formed on the whole lengths of the conductors 7 and 10 , respectively before forming an insulation, it is preferred for reducing the cost of the insulated wire that after the insulation is removed at the end of the insulated wire to expose the conductor, the exposed conductor is dipped in a solder bath to form a solder coating only on the exposed part, and then the spiral part is formed. It is also possible that after forming the spiral part with the conductor, the spiral part is dipped in a solder bath to form a solder coating only on the spiral part.

[0035] Figure 4A is a perspective view showing a conductor comprising a stranded wire, and Fig. 4B is a perspective view showing an insulated wire having a spiral end comprising an insulated wire having the stranded conductor. A stranded wire of a conductor 11 shown in Fig. 4A is of right-hand lay (Z-twisted), whereas a spiral part 12 of an insulated wire having a spiral end shown in Fig. 4B is of left-hand lay (S-twisted). When the stranding direction of the conductor 11 and the spiral direction of the spiral part 12 are opposite to each other, the stranded wire can be prevented from unraveling on forming the spiral part. In the case of an insulated wire comprising a stranded wire having an insulation thereon, it is possible that the strand is unraveled on removing the insulation at the end of the wire. In such a case, the spiral part is formed after twisting the conductor by hand. It is possible that a solder coating is formed after twisting, and then the spiral part is formed.

[0036] In an electronic equipment, such as a portable personal computer, a long and narrow cold cathode tube having a diameter of several millimeters is used for the backlight of a liquid crystal display. The cold cathode tube has a pin terminal comprising a copper-plated iron-nickel alloy wire having a diameter of about 0.4 to 0.8 mm and a length of about 3 to 10 mm, which is generally called a Jumet wire. In order to supply electric power to the cold cathode tube, it is necessary to connect the pin terminal to an electric wire.

[0037] A plastics insulated wire having an outer diameter of about 1.0 to 2.0 mm, of which a conductor comprises 7 strands of 0.1mm wire or 19 strands of 0.16mm wire, is employed as the electric wire for supplying an electric power.

[0038] Figure 5 is a perspective view showing an example of a connecting part using the insulated wire having a spiral end according to the invention for a backlight of a liquid crystal display of a portable computer. In Fig. 5, numeral 13 denotes a pin terminal, 14 denotes a cold cathode tube, and other numerals have the same meanings as in Figs. 1A to 1D. The pin terminal 13 is inserted into a central opening of the spiral part 4 of the insulated wire having a spiral end, and fixed thereto with a fixing material, such as solder, not shown in the figure. At the time when the pin terminal 13 is inserted into the central opening of the spiral part 4, because the insulated wire 3 is retained by the pin terminal 13 (temporary fixing), it is not necessary to hold the conductor 1 of the insulated wire 3 with a specific tool such as pinchers, and therefore, the fixing operation with a fixing material such as solder can be easily conducted.

[0039] In the case where the pin terminal 13 is a leader line of the cold cathode tube 14, and the heating time for soldering or the like is required to be shortened, it is possible that a solder coating is previously formed on the conductor 1 in the spiral part 4, and after inserting the pin terminal 13 into the central opening of the spiral part 4, the solder coating is melted by heating the spiral part 4 to fix the conductor 1 in the spiral part 4 to the pin terminal 13. By using this procedure, the heating time can further be shortened, and there is no fear of damaging the cold cathode tube, etc. by heat. Furthermore, because solder spreads over the whole circumference of the pin terminal and the whole circumference of the spiral, the pin terminal 13 and the conductor 1 are firmly fixed to each other. The fixing strength of the conductor to the pin terminal can further be increased by soldering to the connecting part, in addition to the fixation by melting the coating solder.

[0040] While an example where the pin terminal 13 is fixed to the cold cathode tube 14 is shown in Fig. 5, the pin terminal 13 may be those fixed to any apparatus.

Claims

1. An insulated wire having a spiral end produced by a process comprising removing an insulation at an end of an insulated wire to expose a conductor; and winding the exposed conductor into a spiral form by 1.5 folds or more to produce a spiral part at an end of the conductor.

2. An insulated wire having a spiral end produced by a process comprising removing an insulation at an end of an insulated wire to expose a conductor; and winding the exposed conductor into a spiral form by 2 folds or more to produce a spiral part at an end of the conductor.

3. An insulated wire having a spiral end as claimed in claim 1, wherein a central axis of the spiral part and a central axis of the insulated wire are substantially parallel.

4. An insulated wire having a spiral end as claimed in claim 1, wherein a central axis of the spiral part intersects a central axis of the insulated wire at substantially right angles.

5. An insulated wire having a spiral end as claimed in claim 1, wherein the conductor in at least the spiral part has a solder coating.

6. An insulated wire having a spiral end as claimed in claim 1, wherein the conductor is a stranded wire, and the spiral part has a spiral direction opposite to the stranding direction of the stranded wire.

7. A method for connecting an insulated wire having a spiral end comprising the steps of: inserting a pin terminal into a central opening of a spiral part of an insulated wire having a spiral end; and fixing the spiral part and the pin terminal with a fixing material, the insulated wire having a spiral end being produced by a process comprising removing a covering at an end of an insulated wire to expose a conductor; and winding the exposed conductor into a spiral form by 1.5 folds or more to produce the spiral part at the end of the conductor.

8. A method for connecting an insulated wire having a spiral end as claimed in claim 7, wherein the conductor in at least the spiral part has a solder coating, and after inserting the pin terminal into the central opening of the spiral part, the spiral part and the pin terminal are fixed by heating and melting the solder coating.

Amended claims under Art 19.1 PCT

1. (Amended) An insulated wire having a spiral end produced by a process comprising removing an insulation at an end of an insulated wire to expose a conductor; and winding the exposed conductor into a spiral form with gaps of 0 ~ 0.1mm by 1.5 folds or more to produce a spiral part at an end of the conductor.

2. (Amended) An insulated wire having a spiral end produced by a process comprising removing an insulation at an end of an insulated wire to expose a conductor; and winding the exposed conductor into a spiral form with gaps of 0 ~ 0.1mm by 2 folds or more to produce a spiral part at an end of the conductor.

3. An insulated wire having a spiral end as claimed in claim 1, wherein a central axis of the spiral part and a central axis of the insulated wire are substantially parallel.

4. An insulated wire having a spiral end as claimed in claim 1, wherein a central axis of the spiral part intersects a central axis of the insulated wire at substantially right angles.

5. An insulated wire having a spiral end as claimed in claim 1, wherein the conductor in at least the spiral part has a solder coating.

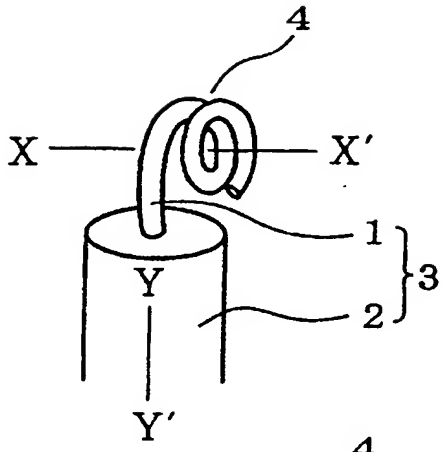
6. An insulated wire having a spiral end as claimed in claim 1, wherein the conductor is a stranded wire, and the spiral part has a spiral direction opposite to the stranding direction of the stranded wire.

7. (Amended) A method for connecting an insulated wire having a spiral end with gaps of 0 ~ 0.1mm comprising the steps of: inserting a pin terminal into a central opening of a spiral part of an insulated wire having a spiral end; and fixing the spiral part and the pin terminal with a fixing material, the insulated wire having a spiral end being produced by a process comprising removing a covering at an end of an insulated wire to expose a conductor; and winding the exposed conductor into a spiral form by 1.5 folds or more to produce the spiral part at the end of the conductor.

8. A method for connecting an insulated wire having a spiral end as claimed in claim 7, wherein the conductor in at least the spiral part has a solder coating, and after inserting the pin terminal into the central opening of the spiral part, the spiral part and the pin terminal are fixed by heating and melting the solder coating.

FIG. 1

(A)



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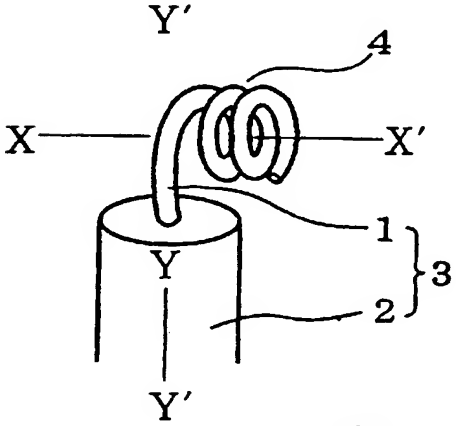

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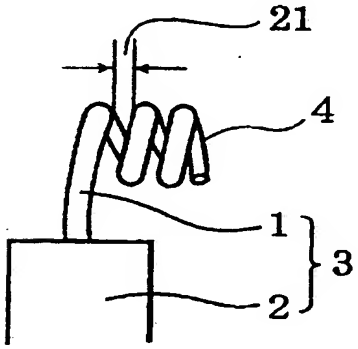

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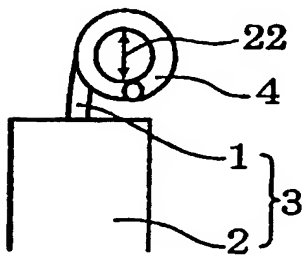
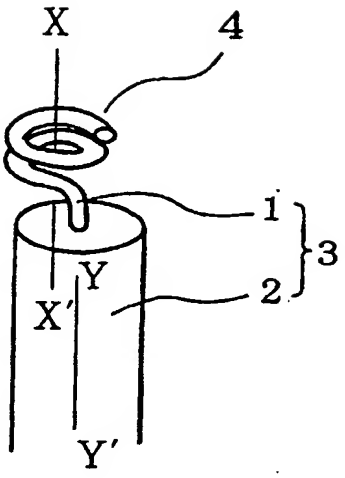


FIG. 2

(A)



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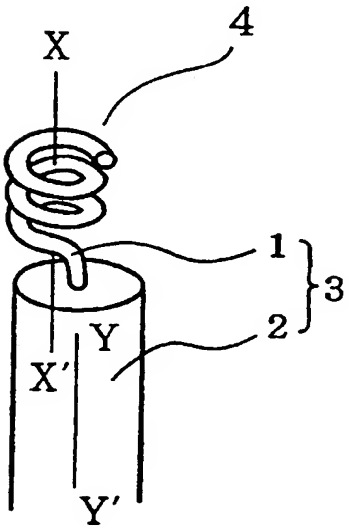


FIG. 3

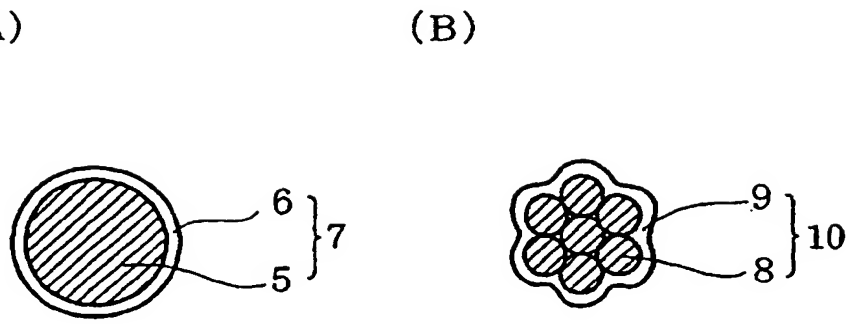


FIG. 4

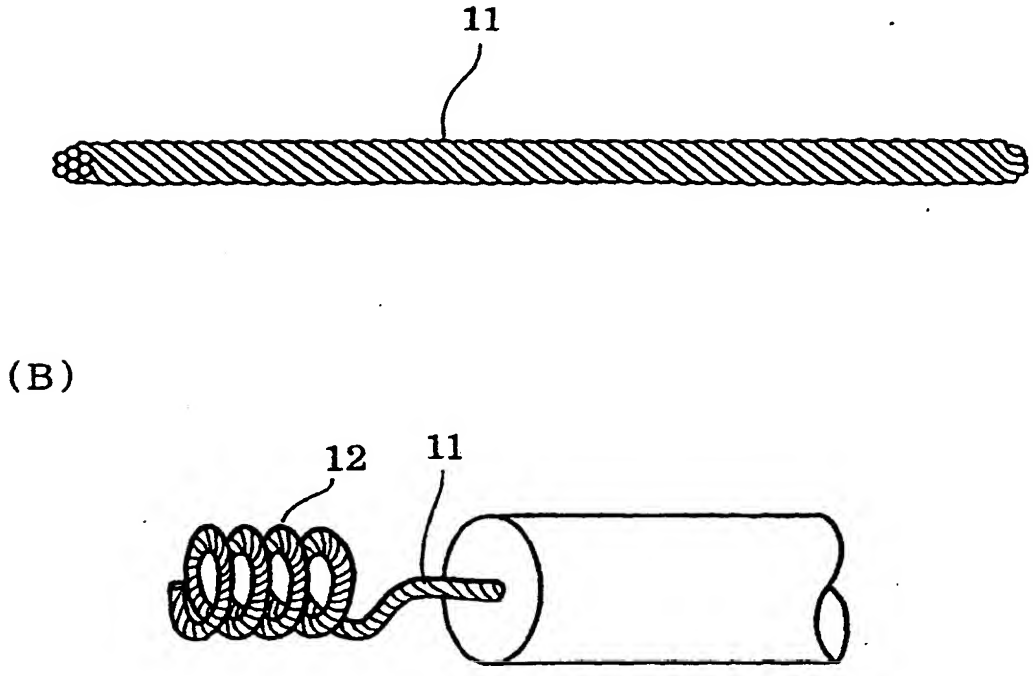


FIG. 5

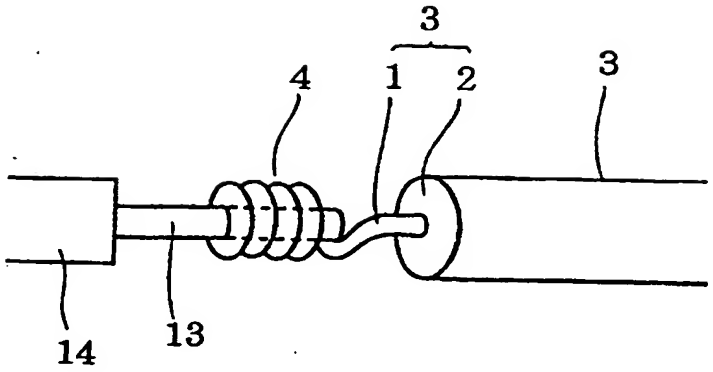
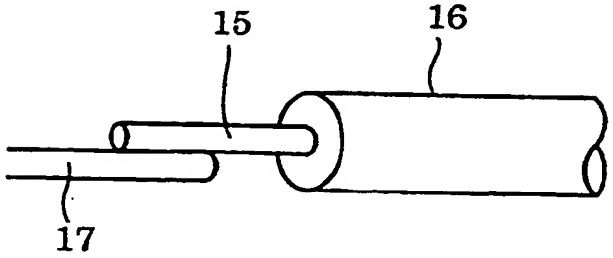


FIG. 6

(A)



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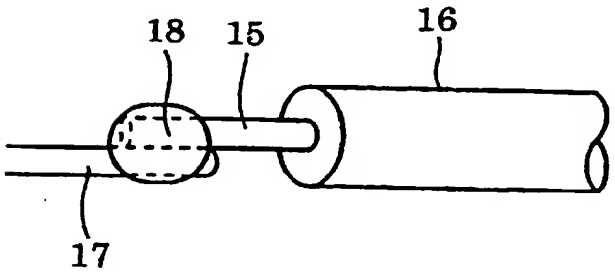
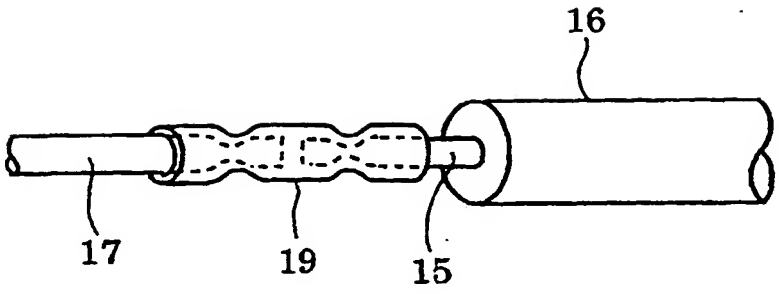


FIG. 7

(A)



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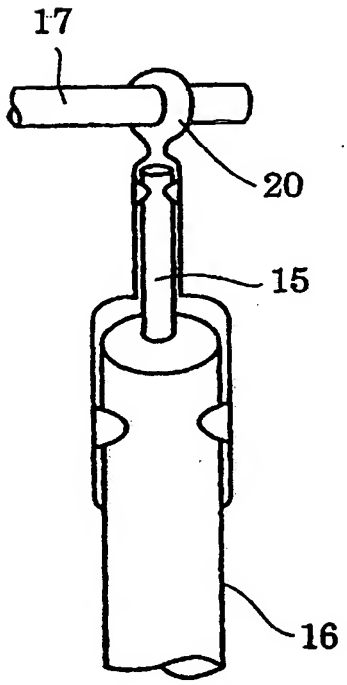

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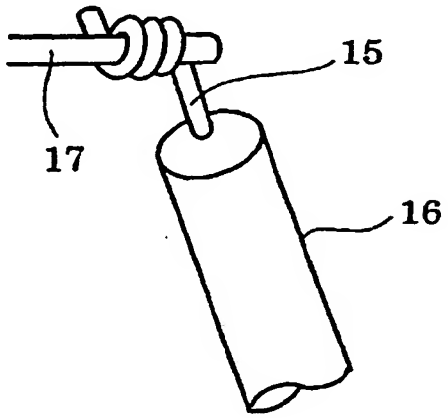

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/00880

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01B7/00, H01R4/14, H01R43/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] H01B7/00, H01R4/14, H01R43/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2000
Kokai Jitsuyo Shinan Koho 1971-2000 Jitsuyo Shinan Toroku Koho 1996-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP53-96489A(Matsushita Electric Ind. Co., Ltd.) 23.August.1978(23.08.78), Full text, (Family: none)	1,2,4 1-8
X Y	JP50-150887A(Hitachi, Ltd.) 3.December.1975(03.12.75), Claims 1,3, Figs. 1,2(Family: none)	1,2,4-6 1-8
Y	JP55-69910A(Sumitomo Electric Industries, Ltd.) 27.May.1980(27.05.80), Claims 1; Fig.3 (Family: none)	1-8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 May, 2000 (10.05.00)	23.05.00
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)